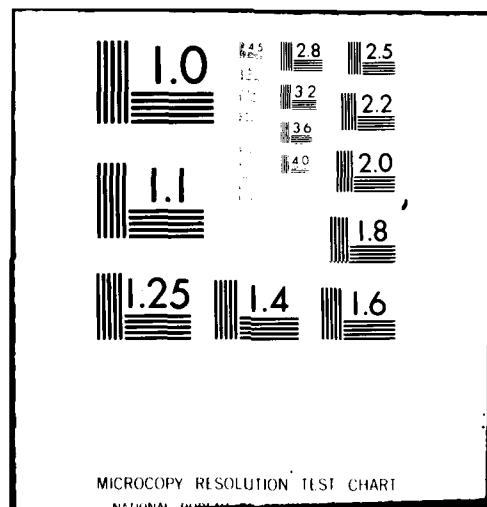


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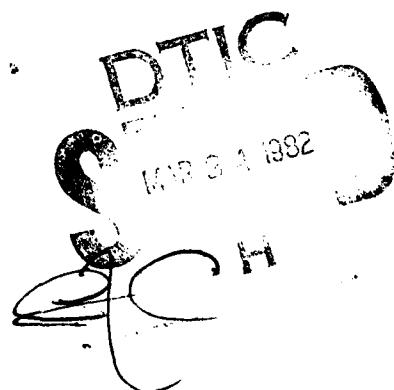
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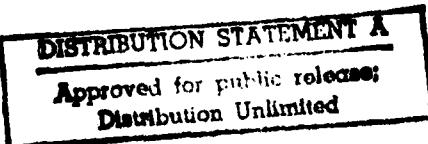
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The United States Air Force



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The subject of this note concerns the efforts of developing countries to reduce their dependence on the advanced industrial states, including the development of domestic arms industries. Data are presented on arms production by country for three points in time (1969, 1970, 1980) on four types (and sub-types) of weapons: aircraft, armored vehicles, missiles, and naval vessels. The major increase in weapons production came during the 1970s-15 developing countries produced arms in 1960, 18 in 1970, and 28 in 1980. Non-economic motivations to produce weapons are hypothesized to include external and internal security threats, vulnerability to manipulation by exporters, insecure military security relationships, and national pride, economic goals, import substitution, export potential, and technological stimulation of other sectors.
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A RAND NOTE

ARMS PRODUCTION IN DEVELOPING COUNTRIES:
THE CONTINUING PROLIFERATION OF
CONVENTIONAL WEAPONS

Andrew L. Ross

October 1981

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PREFACE

The research reported here was performed by the author during his tenure in Rand's Graduate Student Summer Program in 1980. It forms part of his dissertation research at Cornell University. Preparation of this Note was funded by Project AIR FORCE as part of the concept development effort under the Resource Management Program.

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SUMMARY

The efforts of developing countries to reduce their dependence upon the advanced industrial states include the development of domestic arms industries--the subject of this Note. Data are presented on arms production by country for three points in time (1960, 1970, 1980) on four types (and sub-types) of weapons: aircraft, armored vehicles, missiles, and naval vessels. Each entry is assigned a level of manufacturing capability ranging from licensed assembly to independent R&D and production.

The major increase in weapons production came during the 1970s--15 developing countries produced arms in 1960, 18 in 1970, and 28 in 1980. In 1980, 16 countries produced aircraft, six produced armored vehicles, nine produced missiles, and 25 produced naval vessels. Both the variety of types as well as the level of indigenous content increased also during this period. For example, in 1960, aircraft production centered around basic propeller-driven trainers, with only three countries reaching the level of dependent R&D and production. By 1980, eleven LDCs were producing basic trainers, four of which were the result of indigenous R&D; five produced fighters; and eleven produced helicopters.

Non-economic motivations to produce weapons are hypothesized to include external and internal security threats, vulnerability to manipulation by exporters, insecure military security relationships, and national pride, economic goals, import substitution, export potential, and technological stimulation of other sectors. Future research will investigate the relative significance of these variables by using both broadly based aggregate data analysis and in-depth case studies of four selected countries. This research should help determine whether indigenous arms production actually reduces dependence on the industrialized countries, or whether one type of dependence is simply traded for another--that is, a move from dependence on the supply of a final product to dependence in the supply of technology.

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I. INTRODUCTION: THE PURSUIT OF INDEPENDENCE

The efforts of developing countries¹ (LDCs) to reduce their collective and individual independence upon the advanced industrial states have received considerable attention in both policy and academic circles. Attempts to improve their terms of trade, regulate multinational corporations, form cartels among the producers of primary goods and raw materials, and gain a greater voice in international trade and monetary institutions in a concerted effort to bring about a New International Economic Order have become standard subject matter in policy-oriented research. Developing country programs aimed at reducing military dependence upon the industrial states have received relatively little notice, however.

Developing countries have viewed the establishment of indigenous arms industries as crucial in the reduction of their military dependence. Most leaders in these countries would agree with the declaration of Brazil's Air Force Minister that, "The time has come to free ourselves from the United States and the countries of Europe. It is a

¹The terms "developing country," "less developed country," and "Third World" are used interchangeably here. The question of what a developing country is is determined in a dialectical manner--that is, in terms of what it is not. On the economic level, it is not a member of the OECD, EEC, EFTA. On the military level, it does not belong to NATO or the Warsaw Pact. This may still leave the status of a few countries uncertain. Using the center-periphery conceptualization of dependency theorists, however, that uncertainty can be largely eliminated. Countries such as Spain, Portugal, and Turkey can be considered to be part of the periphery of the center, while countries such as the United States, Britain, France, and the FRG are the center of the center. Similarly, countries such as Brazil, India, and Nigeria may be considered to be the center of the periphery and those such as Burma, Bangladesh, and Togo the periphery of the periphery. The center-periphery distinction employed here is broader than the narrowly economic usage of most dependency theorists. The present distinction is based on political and military factors as well as economic. This usage of the center-periphery distinction on the international level is similar to that employed by Johan Galtung on the domestic level in his "A Structural Theory of Imperialism," *Journal of Peace Research*, 1971, No. 2, pp. 81-117.

condition of security that each nation manufacture its own armaments."¹ Domestic arms industries are perceived as the means by which developing countries can reduce and eventually eliminate their dependence on arms imports from the developed countries, imports which have increased from a value of \$5,729 million in 1970 to \$11,152 million (in constant 1975 dollars) in 1977.²

The general development of developing country arms industries during the 1960s and 1970s, and the limited steps toward the goal of military independence that development represents, parallels the evolution of LDC demands for and attempts to move toward political and economic independence from the industrial states. Just as much of the intra-LDC foundation for confrontation with the industrial states on political and economic issues was laid during the late 1950s and 1960s, resulting in the often acerbic polarization of the 1970s, the foundation for movement toward military independence of these countries was also laid during the 1960s, with the dramatic increase in arms production coming during the 1970s. But while action on the political and economic front was often characterized by the militant posturing of developing country formations such as the Group of 77, action on the military front was rather unspectacular, involving quiet negotiations resulting in the license agreements that have provided the basis for the subsequent development of domestic arms industries. Despite the differing tactics LDCs have employed on the two fronts, however, their activity in the military sphere is a manifestation of the same phenomenon evident on the economic level. Both represent an attempt to reduce the level of dependence upon the advanced industrial states.

¹ Statement by Joelmir Compos de Araripe Macedo. Quoted in Michael Moodie, "Sovereignty, Security, and Arms," *The Washington Papers*, Vol. VII, No. 67, Beverly Hills: Sage Publications, Inc., 1979, p. 23.

² Derived from arms transfer data in *World Military Expenditures and Arms Transfers 1968-1977*, United States Arms Control and Disarmament Agency, Publication 100, October 1979.

Arms production in developing countries increased tremendously throughout the 1970s, with Brazil, India, and Israel leading the way. Developing countries now produce a wide variety of weapons, ranging in technological sophistication from small arms and ammunition to armored vehicles, guided missiles, and jet fighters. These developments, however, have gone largely unnoticed in the literature. Those concerned with the horizontal proliferation of conventional weaponry have focused on arms transfers from the advanced industrial states to the developing countries, usually ignoring the implications of domestic arms production.¹

In this Note I will discuss (1) the stages of development of developing country arms industries; (2) the various types of conventional weapons LDCs are producing; and (3) the implications of and prospects for LDC arms production. Since the arms production data have been compiled according to the stage of development of four sectors of each country's arms industries, I will begin with a description of that developmental process and then proceed to a discussion of what LDCs are and have been producing.

¹For exceptions see Michael Moodie, "Sovereignty, Security, and Arms," *op. cit.*, and "Defense Industries in the Third World: Problems and Promises," in Stephanie G. Neuman and Robert E. Harkavy, *Arms Transfers in the Modern World*, New York: Praeger Publishers, 1980, pp. 294-312; Peter Lock and Herbert Wulf, "Register of Arms Production in Developing Countries," Hamburg, March 1977, mimeo; "Arms Trade and Transfer of Military Technology," *Bulletin of Peace Proposals*, Vol. 8, No. 2, 1977; "Domestic Defense Production in Third World Countries," *The Arms Trade with the Third World*, New York: Humanities Press, 1971; and David K. Whynes, *The Economics of Third World Military Expenditures*, Austin: University of Texas Press, 1979, pp. 43-49.

II. LDC ARMS PRODUCTION: STAGES OF DEVELOPMENT

The pattern of development of LDC arms industries appears to be fairly uniform both cross-nationally and for different weapons systems. Five distinct developmental stages have been identified.¹ Before engaging in the domestic production of arms, however, LDCs import weapons and the technological skills and equipment necessary for their repair and maintenance. The transfer of this preproduction military and industrial technology enables developing countries to acquire skills and equipment that will be of use in the evolution of indigenous RDT&E and production programs. Both India and Israel went through this process in the 1950s, with the Israeli aircraft industry growing directly out of a maintenance capability.

The first stage of domestic arms production involves the assembly of arms. Developing countries usually continue to purchase arms from foreign suppliers, but assemble weapons domestically under license agreements, with prefabricated components being shipped from supplier states to LDCs to be assembled there. The technology transfer process continues here as foreign producers provide the training and facilities necessary for weapons assembly. Training includes not merely assembly skills, but also the use of equipment needed to inspect, evaluate, and test the arms being assembled. Therefore, further technological competence is acquired that can be applied in domestic arms industries. Examples of assembly include Brazilian assembly of the French Lama general purpose helicopters and Peruvian assembly of the Soviet Mi-6 helicopter.²

In the second stage, LDCs begin to produce weapons components under license. Although the complete weapon system itself is merely assembled, an increasing number of components are produced domestically,

¹ For alternative formulations of the stages of development of LDC arms industries, see Moodie (1979), *op. cit.*, pp. 46-48, and Gregory R. Copley, Michael Moodie, and David Harvey, "Third World Arms Production: An End to Embargoes?" *Defense and Foreign Affairs Digest*, Vol. 6, No. 8, August 1978, pp. 10-11.

² A heavy transport helicopter. NATO name for the Mi-6 is "Hook."

as in Argentinian production of the Hughes OH-6 helicopter. It is also during this stage that developing countries often begin to reap export earnings from their arms industries, earnings that can be channeled back into the industry to fund R&D and further expansion, since the components are often sold to the licensors.

The third stage begins when LDCs produce complete weapons systems. This often involves purchasing the entire arms production facility, a "turn-key" plant, from an industrialized supplier. Even at this stage, however, some vital components may still be imported. Examples here include Indian production of the Soviet MiG-21 fighter, Brazilian production of the Cobra anti-tank missile, and Argentinian production of the French AMX light tank.

In the fourth stage, developing countries reproduce, through reverse engineering, or modify and redesign foreign weapons systems. Using the technological skills acquired in earlier stages, weapons previously produced under license may be substantially modified, or foreign designed weapons may be reproduced in disregard of conventional licensing formalities. This is the first stage in which some element of domestic R&D appears--in the form of either system redesign or reverse engineering. As in the third stage, however, some vital components may still be imported. This stage is exemplified by Indian production of the Vijayanta, a modified version of the Vickers Armstrong Chieftain.

In the fifth and final stage, developing countries indigenously design and produce arms. This stage can be reached very quickly in the production of relatively unsophisticated weapons, but very few LDCs have reached this stage in the production of technologically advanced systems. For these more advanced weapons there may be two steps in this stage: the first is indigenous R&D and production with high reliance on foreign sources for vital components; the second involves domestic R&D and production with most components domestically manufactured. In the first step, which may be labeled dependent R&D and production, production is based on domestic R&D, though utilizing some, and perhaps vital, foreign components. In the second step, independent R&D and production, production is based primarily on locally designed

and manufactured components. Both the components and the integrated system are the result of indigenous R&D. The Indian designed Marut fighter and Kiran trainer, both of which use British Orpheus turbojets, are examples of the first step of this final stage, while the Israeli Gabriel ship-to-ship missile and Luz air-to-ground missile are illustrative of the second step.

The developmental process described here is both a model, similar to Raymond Vernon's product cycle model, that posits sequential stages in the development of an arms industry, and an ideal type, i.e., a theoretical abstraction of the developmental process. Although the model may not precisely describe the development of arms industries in every instance, it is an ideal type against which actual developmental processes may be evaluated and measured. The model also provides a basis for comparison both across countries and across the various weapons systems by facilitating an evaluation of the stage of development of an arms industry as a whole, as well as specific sectors, according to a standard scheme of classification.

III. DEVELOPING COUNTRY WEAPONS PRODUCTION: 1960, 1970, AND 1980

Developing countries produce a wide variety of military hardware, ranging from relatively uncomplicated items such as arms and ammunition to more technologically advanced weapons such as armored vehicles, guided missiles, and jet fighters. The state of development of LDC arms industries also varies widely, with most countries still in the early stages, concentrating on assembly and licensed production of basic weapons. The state of development of arms industries varies within as well as among LDC arms producers. Within any one country, the various sectors of the arms industry are typically at different stages in the developmental process. Even within one sector, production is often occurring at more than one stage. Moreover, the products themselves differ in their technological complexity--a jet fighter is very different from a basic trainer. A central aim of the research reported in this Note was to compile a consistent data base on LDC arms production, paying particular attention to the stage of industrial capability and to the technical complexity of the product.

An indication of the extent of LDC arms production in 1960, 1970, and 1980 for four sectors of the conventional arms industry is presented in the accompanying tables.¹ Reliable figures for developing country arms production, either the quantity or value of weapons produced, are unavailable. However, another method of determining the extent of LDC arms production may be both informative and useful. This has been done in this Note by determining which stage of production has been reached for each of four categories of conventional weapons: (1) aircraft, (2) armored vehicles, (3) missiles, and (4) naval vessels. Although this method is not a precise substitute for the number and value of arms produced, it does provide a reliable indication of the range of weapons being produced and the stage of development of each of these four sectors of the arms industry, thus providing a basis for comparison of developing country arms producers. Indeed, the number and

¹Methodology and sources behind the tables are given in the Appendix.

value of weapons manufactured would not, by itself, be a reliable indicator of the state of development of domestic arms industries.

Focusing on the stage of development of each of the four sectors provides a more reliable indication of the demonstrated technical capabilities of LDC arms production than would concentrating on either the value or number of weapons produced.

Turning to Tables 1-8, we find evidence contradicting SIPRI's claim that, "In 1960, virtually no third world country possessed the capacity to produce major arms--with the notable exception of Argentina and Brazil."¹ In fact, 15 developing countries produced arms in 1960. There was little increase in the number of producers during the 1960s, and by 1970 only 18 LDCs could be counted among the arms producers. The major increase in weapons production came during the 1970s--by 1980 28 developing countries were producing major weapons systems.

Of the four types of conventional weapons for which I have gathered data, only aircraft and naval vessels were produced in 1960, with six countries producing aircraft and thirteen producing naval vessels. But by 1970, all four types of weapons were being produced, with seven countries producing aircraft, four producing armored vehicles, three producing guided missiles, and fifteen producing naval vessels. In 1970, however, only one country, India, produced weapons in each of the four categories.

In 1980, six countries, Argentina, Brazil, India, Israel, South Korea, and South Africa, produced each of the four types of weapons. Of the 28 arms producers in 1980, 16 manufactured aircraft, six manufactured armored vehicles, none produced missiles, and 25 produced naval vessels.

Thus there has been a marked increase in developing country arms production since 1960, with the greatest increases for every category of weapons coming in the 1970s. Not only has there been an increase in arms production per se, there has also been a significant increase in the range of weapons produced in each of the four categories and in

¹ *World Armament and Disarmament: SIPRI Yearbook 1975*, Cambridge, Massachusetts, and London: The MIT Press, and Stockholm: Almqvist and Wiksell, 1975, p. 195.

the level of indigenous content.

As can be seen in Tables 1 and 5, aircraft production in 1960 centered around basic propeller-driven trainers, with only three countries having reached stage five, dependent R&D and production, in the production of these trainers. Only one country, India, was engaged in fighter production, and its "production" merely involved assembly. By 1970 aircraft production still centered around trainers, but production had expanded to include turbojet as well as turboprop trainers. In addition to the three countries producing indigenously designed basic trainers, four countries were also manufacturing jet trainers, with one the result of domestic R&D. India by 1970 had generated its own fighter, and both Taiwan and India had initiated licensed production of helicopters. The pace of aircraft production increased during the 1970s, and in 1980 eleven LDCs were producing basic trainers, four of which were the result of indigenous R&D; five were producing fighters; and eleven were producing helicopters.

Only one country, India, was producing aircraft engines in 1960. In 1970 there were still only two LDCs producing aircraft engines. The number increased to five by 1980, but only one developing country had advanced further than co-production of aircraft engines.

While no developing countries were producing armored vehicles in 1960, in 1970 four LDCs were engaged in the manufacture of armored vehicles (Tables 2 and 6). Of these four countries, two, Argentina and India, were co-producing tanks. Only two more countries had joined the ranks of armored vehicle producers by 1980, but the range of armored vehicles in production had increased dramatically. In 1980, five countries were producing tanks and armored personnel carriers, two were producing armored cars and reconnaissance vehicles, and one country, Brazil, was even producing a domestically designed armored bridge-layer. Brazil's production of armored vehicles saw an especially dramatic increase, with a number being exported to Libya and Iraq, and with numerous other countries expressing interest in these vehicles.

As was the case with armored vehicles, so it was with guided missiles (Tables 3 and 7). But while no developing countries were producing missiles in 1960, by 1970 three countries had entered missile

production and the number further increased to nine by 1980. An entire range of guided missiles, from surface-to-air to antitank, were in production by 1980, and five countries were producing indigenously designed missiles.

The production of naval vessels in developing countries has centered around patrol craft (Tables 4 and 8). In 1960 eight countries were building patrol craft, including four producing domestically designed vessels. The number of patrol craft producers only increased to eleven by 1970, but the 1970s saw that number rise to twenty by 1980, with twelve countries building indigenously designed patrol craft. The twenty-five producers of naval vessels in 1980 included four countries building frigates and three building submarines.

Thus it is quite evident that developing country arms production has increased substantially since 1960. The 1970s saw a surge in both the number of countries producing weapons and in the range of weapons produced. This increase has come about through indigenous R&D as well as license production. By 1980, eighteen developing countries had advanced to the stage at which production of aircraft, armored vehicles, missiles, or naval vessels was based on indigenous R&D.

Table 1

AIRCRAFT PRODUCTION BY COUNTRY, YEAR, AND STAGE OF DEMONSTRATED
MANUFACTURING CAPABILITY

1980

Country	Fighters	Trainers Jet	Trainers Basic	Maritime Reconnaissance	Transports	Helicopters	Aircraft Engines	Avionics
Argentina		5P ¹ *	5		5	2,5P		
Brazil	2 ³	3,3P	5,5P	5	5	1,3	2 ²	5
Chile	1P	3P						
Colombia					3P			
Egypt	3P	3P	5			3P	4 ⁴ ,3P	
India	3,3P,4	4,5	5		3,3P	3,5P	2,3,3P	3
Indonesia			3		3	1		
Iran ⁵						3P		
Israel	2 ⁶ ,3,4,5P			4	5		2,3	5
Jordan	1P							
Korea, North	3							
Korea, South	1P					2		
Libya			1					
Mexico	3P				3P			
Nigeria						1		
Pakistan	3P		3			1		
Peru						1		
Philippines			4		1		2	
South Africa	2	4			4	2		
Taiwan	3,5P		4,5P		5P	3		3
Thailand			3					
Vietnam ¹³	*		3					

1970

Argentina			5		5			
Brazil			5		5P			
Egypt		3	5				4	
India	3,5	5			3	2	3,5P	
Israel		3			5			
South Africa		3					3	
Taiwan			4					

1960

Argentina			3,5		5			
Chile			5					
Egypt		3	4					
India	1,5P		5					
Indonesia			4					
Israel		1						

* Footnotes for Tables will be found on p. 15.

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

Table 2

ARMORED VEHICLE PRODUCTION BY COUNTRY, YEAR, AND
DEMONSTRATED MANUFACTURING CAPABILITY

1980

Country	Tanks	Armored Personnel Carriers	Armored Cars	Reconnaissance Vehicles	Armored Bridgelayer
Argentina	4	3,4			
Brazil	5	5	5	5	5
India	3,5P	3			
Israel	5			5	
Korea, South	4,5P	3			
South Africa		5	4		

1970

Argentina	3
Brazil	
India	3
South Africa	3

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

Table 3

MISSILE PRODUCTION BY COUNTRY, YEAR, AND
DEMONSTRATED MANUFACTURING CAPABILITY

1980

Country	Surface-to-Air	Air-to-Ground	Air-to-Air	Surface-to-Surface	Anti-tank
Argentina		5.5			4
Brazil	3,5,5	5.5	4,5P		3
Egypt	3P				3
India	3		3		3
Iran	3P	3P			3P
Israel	3	5.5	4	5.5	5.5
Korea, South				4	
Pakistan					3
South Africa	5 ^{7*}		5.5		
Taiwan	3		3	3,4	5.5

1970

Brazil			5P
India		3	
Israel			5.5
Pakistan			3
South Africa	5P	5P	

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

*Footnotes for tables will be found on p. 15.

Table 4

NAVAL VESSEL PRODUCTION BY COUNTRY, YEAR, AND DEMONSTRATED
MANUFACTURING CAPABILITY

1980

Country	Frigates	Corvettes	Patrol ^{8*} Craft	Submarines	Mine Warfare Forces	Amphibious Craft ⁹	Support ¹⁰ Craft
Argentina	3		3	1			5
Bangladesh			5				
Brazil	3		5	3P		5	5
Colombia				1			
Dominican Republic							5
Egypt			4				
Fiji							5
Gabon			5				
India	3,5 ¹¹	5P	5	5P			5
Indonesia			5				
Israel		5	3,4,5				
Ivory Coast							5
Korea, North	3		3	3		3	
Korea, South		5P		3,5			
Malagasy Republic							4
Malaysia			2				
Mexico			3				
Peru	3P		5				5
Philippines			3				
Singapore			3,5				
South Africa			3,5				
Sri Lanka			5				
Taiwan			3				
Thailand			5 ¹²				5
Trinidad			5P				
Venezuela			3				

1970

Argentina		5					
Brazil		5					
Chile		3					5
Gabon		5					
India	3				3		5
Indonesia			5				5
Israel						5	5
Ivory Coast						5	
Korea, North		4	3				
Korea, South			3				
Mexico			5				
Peru							5
Singapore			3				
Taiwan			5				
Thailand			4				

1960

Argentina	5						5
Brazil							
Burma	3	3					5
Colombia			5				
Dominican Republic						5	
Egypt			4				
India							5
Indonesia			5				
Korea, North		3	3				
Mexico			5				5
Peru							5
Singapore			3				3
Thailand			5 ¹²				

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly	5. Dependent R&D and Production
2. Licensed Component Production	5.5. Independent R&D and Production
3. Licensed System Production	P Planned
4. System Modification/Reverse Engineering	

*Footnotes for tables will be found on p. 15.

FOOTNOTES FOR TABLES 1-4

¹ Being developed in cooperation with Dornier of FRG.

² Subcontractor for components of PT-6 Pratt and Whitney turboprop.

³ Subcontractor for F-5E components.

⁴ Copy of Soviet MiG engine.

⁵ Projects planned to be undertaken by the Shah.

⁶ Subcontractor for F-15 components.

⁷ Jointly developed by South Africa and France.

⁸ Patrol craft includes various types of coastal patrol craft as well as fast attack craft and gunboats.

⁹ Amphibious craft includes landing craft.

¹⁰ Support craft include torpedo recovery vessels, tankers, transports, survey vessels, and logistics ships.

¹¹ Now under construction.

¹² May have involved Japanese collaboration.

Table 5

**NUMBER OF COUNTRIES PRODUCING AIRCRAFT,
BY TYPE, STAGE, AND YEAR**

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

Table 6

NUMBER OF COUNTRIES PRODUCING ARMORED VEHICLES,
BY TYPE, STAGE, AND YEAR

	1980					1970						
	Producers Per Stage					Total Producers	Producers Per Stage					Total Producers
	1	2	3	4	5		1	2	3	4		
Tanks	1	2	2	2	5	5	2				2	
Armored Personnel Carriers	3	1	2	2	5	5						
Armored Cars		1	1	1	2	2		1	1	1	2	
Reconnaissance Vehicles			2		2	2						
Armored Bridgelayer				1	1	1						
Total Armored Vehicle Producers					6	6					4	

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

Table 7

NUMBER OF COUNTRIES PRODUCING MISSILES,
BY TYPE, STAGE, AND YEAR

	1980						1970					
	Producers Per Stage					Total Producers	Producers Per Stage					Total Producers
	1	2	3	4	5		1	2	3	4	5	
Surface-to-air	4		1	1		5						
Air-to-ground					3	3						
Air-to-air	2	2		1		5			1			1
Surface-to- surface	1	2		1		3				1		1
Anti-tank	4	1		2		7			1			1
Total Missile Producers						9						3

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

Table 8

NUMBER OF COUNTRIES PRODUCING NAVAL VESSELS,
BY TYPE, STAGE, AND YEAR

	1980					1970					1960									
	Producers Per Stage					Total Producers					Producers Per Stage					Total Producers				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Frigates	4	1			4		1			1						1	1			
Corvettes			1		1			1		1						2				2
Patrol Craft	1	10	2	12	20		3	1	7	11						3	1	4		8
Submarines	2		1			3														
Mine Warfare Forces							1			1										
Amphibious Craft	1		2		3			2		2						1	1			
Support Craft	1		6		7			4		4						1	5			6
Total Naval Vessel Pro- ducers					25					15										13

Stages of Demonstrated Manufacturing Capabilities

1. Licensed Assembly
2. Licensed Component Production
3. Licensed System Production
4. System Modification/Reverse Engineering
5. Dependent R&D and Production
- 5.5. Independent R&D and Production

P Planned

IV. DIRECTIONS FOR FUTURE RESEARCH

Having compiled data on developing country arms production, the next step is to investigate the factors underlying LDC decisions to produce arms. There are a number of domestic and international factors motivating LDCs to produce arms. Non-economic variables providing motivations or incentives for developing countries to acquire arms industries, on the international level, include (1) external security threats, (2) vulnerability to the manipulation of dependence upon arms imports, (3) insecure military security relationships, and (4) national pride.¹ The presence of external security threats is the most often cited incentive prompting LDCs to produce arms. India, Israel, the Republic of Korea (ROK), and Taiwan are good examples of arms-producing countries confronted with external threats to their national security. Other developing countries, however, such as Mexico, Indonesia, Brazil, and the Philippines, are faced with insignificant or nonexistent external threats but still produce arms. Thus it is necessary to look beyond the existence of external security threats.

Vulnerability to the manipulation of dependence upon arms imports provides a strong motivation for LDCs to manufacture their own weapons. The French decision to cut off Israeli arms supplies in 1967 and the United States arms embargo on India during the 1971 Indo-Pakistani War both served to accelerate arms production efforts in Israel and India. Manipulation of vulnerability, however, includes not only arms embargoes but also restrictions on the use and resale of arms, restrictions that have played a prominent role in United States arms transfer policy.

Developing country perceptions of insecure military assistance agreements have also prompted LDCs to initiate or step up arms production efforts. The United States proclamation of the Nixon Doctrine

¹ For an economic model of indigenous arms production and trade, see Arthur J. Alexander, William Butz, and Michael Mihalka, *Modeling the Production and International Trade of Arms: An Economic Framework for Analyzing Policy Alternatives*, N-1555-FF, The Rand Corporation, March 1981.

in 1969 provided increased incentive for at least three Asian countries, South Korea, Taiwan, and the Philippines, to initiate domestic arms production programs. Nixon's withdrawal of the 7th Division in 1971 and the Carter administration's 1977 decision to pull United States ground troops out of South Korea, though rescinded, provided further incentive for the South Koreans to enhance national security through indigenous arms production.

The desire to enhance national pride and regional status is another motivating force underlying LDC decisions to engage in the domestic manufacture of arms. An indigenous arms production capability provides the appearance of a certain degree of military independence from the developed countries, thus enhancing a state's regional status and claim to leadership. This symbolic element may be especially significant for states such as Brazil and India which aspire to positions of regional hegemony and leadership.

Two prominent variables on the domestic level are domestic conflict and economic goals. The existence of domestic conflict, especially in the form of armed rebellions or guerrilla warfare, in some cases provides the incentive to produce arms even in the absence of external threats. Neither Indonesia nor the Philippines is confronted with serious external military threats. Both, however, must deal with internal conflicts and in both states arms production is geared toward counter-insurgency equipment.

Economic goals provide strong incentives for the production of weapons. Attempts to reduce dependence upon arms imports through indigenous arms production is a form of import substitution industrialization. Some developing countries perceive militaristic industrialization as providing the industrial infrastructure required for economic development while improving the technological skills of the workforce. These countries often assume that the domestic manufacture of arms will provide expanded employment opportunities for both the highly skilled personnel that would be involved in R&D programs and the relatively unskilled workers that would be employed on factory assembly lines.

Developing countries expect that the development of domestic arms manufacturing capabilities will provide various spin-offs benefiting

civilian as well as military production efforts. The acquisition and working knowledge of advanced computer technology by the arms industry, they argue, will benefit civilian sectors of the economy. And experience gained in designing and producing armored vehicles, military aircraft, and naval vessels may be applied in the non-military transportation, aircraft, and shipbuilding sectors.

Developing countries also hope to improve often-persistent balance of payments problems through the manufacture of weapons. As domestic arms production increases, arms imports can be reduced and foreign earnings can be increased through the export of arms. Significant improvements in the balance of payments may only occur over the long-run, however, since short-term imports of foreign technology and weapons components will increase. Using the arms industry to alleviate a balance of payments deficit would consequently be a long-term strategy.

There are also a number of intervening variables, conditioning or constraining factors, that influence LDC decisions to produce arms. The primary intervening variable on the international level is the availability of technological assistance. Developing countries cannot manufacture advanced weaponry without technological assistance from the industrialized states. Although technological assistance in the form of education, production licenses, and weapons components has seldom posed a significant problem (except for pariah states such as South Africa) due to the relatively large number of advanced industrial states willing to supply military technology, the need to purchase foreign assistance does impose a technological and financial ceiling on LDC arms production efforts.

Intervening variables on the domestic level include type of regime, the dominant role of the state, and level of economic development. Some argue that the type of regime conditions decisions to produce arms. Brazil's dynamic arms industry is often perceived as resulting from its having a military regime. India and Israel, on the other hand, also have advanced arms industries, but have civilian instead of military regimes. It is not military control of the state apparatus that is crucial here. What should be emphasized is the

relative influence of the military in the political arena. LDCs with civilian governments may be as likely to acquire arms production capabilities as those with military regimes. Those developing countries in which the military plays a vital political role, however, may place a higher priority on building an extensive arms industry than those in which the military is relegated to a more minor role.

Another factor conditioning the development of LDC arms industries is the predominant role of the state. In India, for instance, defense production is a state enterprise--the private sector is completely excluded. In other countries, such as the Republic of Korea, where arms production is in the hands of private corporations, state control of the defense industry is still almost absolute. Typically, however, defense production involves both public and private sector enterprises, though the state always plays a dominant role. While the private sector may provide some input into the decision making process, the state itself exercises exclusive control, determining the why, what, when, and with whom of defense production.

The level of economic and industrial development among LDC arms producers varies widely. The extent of industrial development ranges from the relatively advanced industrial infrastructures found in Israel, Brazil, and other "newly industrializing countries" to the practically nonexistent industrial bases found in Bangladesh and Sri Lanka. High, low and middle income developing countries all produce arms. Those LDCs classified as low income developing countries by the OECD's Development Assistance Committee include Bangladesh, Egypt, India, Indonesia, and Pakistan. Low middle-income arms producers include the Republic of Korea, the Philippines, and Thailand, while those classified as upper middle-income include Argentina, Brazil, Mexico, and the Republic of China (Taiwan). Israel and Singapore are among the higher income developing country arms producers.¹

¹ *Development Co-operation: Efforts and Policies of the Members of the Develop-Assistance Committee, 1978 Review, Report by Maurice J. Williams, Chairman of the Development Assistance Committee, Organisation for Economic Co-operation and Development, 1978, Annex V, pp. 179-181.*

Despite the fact that developing countries at low as well as at relatively high levels of economic development produce arms, the level of economic development does impose significant constraints on arms production. The type of weapons produced and the growth of the defense industry is limited by the existing industrial/technological base and the opportunities that that base provides for expansion. Though it is unclear whether minimum industrial infrastructure must exist before arms production is initiated or whether decisions to produce arms result in the development of the necessary industrial base, it is quite clear that industrial/technological capabilities and the potential for expansion of those capabilities determine the nature of the weapons produced and the subsequent development of defense industries.

A primary problem for future investigation is to determine the relative significance of these independent and intervening variables. This can be done by employing two different approaches: aggregate data analysis and case studies. Some of the independent and intervening variables are more easily operationalized than others. For both external and internal conflict, the analytic data generated by Edward Azar's Conflict and Peace Data Bank (COPDAB) Project could be utilized. COPDAB has used events interaction data to rank external and internal conflict along a scale of 1-15, ranging from total war to unification on the international level and from civil war to governmental programs increasing socioeconomic freedom and equality on the domestic level.¹ Other variables, such as whether a regime is civilian or military, and level of economic development, also pose few operationalization problems. Since some variables, however, such as national pride, are more difficult to deal with using quantitative techniques, case studies of LDC arms production are also required.

The qualitative inadequacies of aggregate data analysis can be compensated for through the use of case studies. Case studies facilitate an in-depth exploration of the role of various inputs. The

¹ For a more complete description of the COPDAB project see Edward E. Azar, "The Conflict and Peace Data Bank (COPDAB) Project," *Journal of Conflict Resolution*, Vol. 24, No. 1 (March 1980), pp. 143-152.

unique combination of similarities and differences among cases should provide the qualitative data necessary for an assessment of the relative significance of the political, military, and economic determinants of decisions to produce arms and possible variations in the pattern of development of arms industries.

V. IMPLICATIONS OF AND PROSPECTS FOR LDC ARMS PRODUCTION

Throughout the first four stages of arms production, and even partially into the fifth and final stage, developing countries are dependent upon foreign sources for either military technology or vital components. Thus instead of arms industries enabling LDCs to rid themselves of dependence upon arms suppliers, there is a change in the nature of that dependence. While developing countries were formerly dependent upon industrialized countries for arms and thus vulnerable to attempts to manipulate that dependence, as LDCs acquire their own arms industries they become dependent upon foreign military technology and sensitive to possible disruptions in the flow of that technology. One type of dependence is substituted for another. Instead of reaching their proclaimed goal of arms independence, developing countries are switching from dependence upon foreign arms *supplies* to dependence upon foreign military *technology*.

More is occurring here than merely a shift from dependence upon arms imports to dependence upon foreign military technology. The nature of that dependence undergoes a subtle but potentially profound transformation as developing countries turn from import to production. Instead of merely importing a finished product, LDCs are importing the technology necessary to domestically produce and design arms. Consequently developing countries are acquiring the means to alter the traditional dependence relationships.

A relationship of dependence is built-in when LDCs import arms. As LDCs initiate arms production programs and begin to import military technology rather than the arms themselves, a more dynamic relationship is established that has an inherent or built-in potential for the elimination, or at least reduction, of dependence upon technological imports. The import of military technology enables developing countries to build up arms industries that may eventually provide the bulk of their required military hardware, thus greatly reducing the need for foreign military equipment. As they gain more experience in the design and production of weapons, LDCs will have the means to become

increasingly less dependent upon foreign military technology. Therefore the transfer of military technology could set in motion a process resulting in a rather dramatic reduction of dependence.

This is not to say that developing countries will soon be capable of producing the most advanced military hardware, or that LCDs will be able to entirely eliminate imports of military technology or even weapons and weapons components. Absolute military independence will not be achieved. Even advanced industrial states import weapons and military technology. It is, however, entirely conceivable that LDC dependence upon imported arms and military technology can be dramatically reduced. Developing countries do not require the most advanced equipment available to be able to cope with most existing or future intra-LDC security problems.¹ LDC arms production could therefore result in a profound transformation in the nature of LDC-developed nation relations (at least for select LDCs).

The role of arms exports may be crucial in developing country progress along the dependence-independence continuum toward reduced dependence. Few developing countries possess a domestic market sufficiently large to support an efficient indigenous arms industry. Movement toward independence requires a larger market than can be found domestically, a market that can only be found abroad. It is only through exporting arms that developing countries can take advantage of increasing returns to scale and thereby acquire a profitable, self-sustaining arms industry. The profits earned from foreign sales can be used to finance domestic RDT&E and the expansion and improvement of production facilities. Thus the export of arms becomes necessary in the movement away from dependence upon imported arms and military technology.

Complete independence cannot be attained, however, even if developing countries were to accomplish the impossible and reach stage five for all their weapons systems. Even at this stage, LDCs would have to import necessary raw materials, as the developed countries do, and rely upon other states to purchase their arms in order to maintain

¹ It should be emphasized that only conventional, not nuclear, weapons and security problems are under consideration here.

viable arms industries. Though dependence may be reduced, it is never entirely eliminated. Developing countries as well as the industrial states exist in a state of mutual dependence, or interdependence, with other states. Thus far LDCs have been in a position of asymmetrical interdependence and have been vulnerable to manipulation of their dependence. Some developing countries may be able to alter their dependent position, moving to a more symmetrical relationship with developed countries, at least in the production of arms. Though developing countries would be sensitive to fluctuations in the availability and prices of raw materials as well as fluctuations in the arms market, they would no longer be as vulnerable to attempts to manipulate their dependence.¹

Despite the long-term prospects for reduced military dependence, however, few developing countries are approaching arms self-sufficiency. Even the most advanced producers still import weapons. Although a number of countries have reached an advanced stage in the production of a few weapons, this does not imply that, even for those weapons, they have become self-sufficient. Arms imports will continue to play a role in the security policies of the majority of developing countries.

The production of arms by developing countries does, however, have a number of broad-ranging political, military, and economic implications for both domestic and international issues. On the domestic level, arms production may contribute to a country's militarization by reinforcing and enhancing the political strength of the military and buttressing the internal security apparatus of the state. Through acquisition of the means to domestically manufacture the tools of repression, developing countries, for example, could render future human rights policies (under which the United States has refused to sell arms and related items to countries judged to be violators of human rights) and other embargo policies even less effective than they have been in the past.

¹The distinction between vulnerability and sensitivity is drawn from Robert O. Keohane and Joseph S. Nye, *Power and Interdependence: World Politics in Transition*, Boston and Toronto: Little, Brown and Company, 1977, pp. 11-19.

Developing country arms production will also have an impact on future industrial development. Though there is disagreement as to what that impact has been thus far, the effect of arms production on industrial development will not be entirely beneficial. Though arms production may contribute to the development of a more advanced industrial infrastructure, it is also argued that weapons production will distort the process of industrialization. Arms production, as a form of militaristic industrialization, may divert a disproportionate amount of scarce developing country resources to military oriented production, thereby contributing to the neglect of potentially more beneficial non-military industrial sectors.

Arms production is a capital- rather than a labor-intensive industry. Although the acquisition of a weapons production capability provides increased employment opportunities, those opportunities tend to favor personnel with relatively high levels of technological training rather than the unskilled and semiskilled workers that constitute the highest proportion of the labor force. A more appropriate developmental strategy would be to concentrate less on capital-intensive and more on labor-intensive industrial endeavors, thus providing employment opportunities for the relatively more abundant portion of the labor force as well as contributing to industrial development.¹

On the international level, LDC arms production could increase political and military tensions by contributing to arms races in areas such as the Indian subcontinent, the Middle East, the Korean peninsula, and South America. Acquisition of arms production capabilities could prompt neighboring states to undertake a parallel military build-up, either by initiating their own arms production programs or by increasing arms imports.

Substantial domestic arms production capabilities eliminates the

¹See also Herbert Wulf, "Dependent Militarism in the Periphery and Possible Alternative Concepts," and Stephanie Neuman, "Arms Transfers and Economic Development: Some Research and Policy Issues," both in Neuman and Harkavy, and Chapter 3, "Defence and the Economy" in Whynes. For a contrasting view of the impact of arms production on industrial development see Gavin Kennedy, *The Military in the Third World*, London: Gerald Duckworth and Co., Ltd., 1974, Chapter 15.

restraints on war-fighting capabilities imposed by dependence on external sources of arms. The destructiveness and longevity of conflicts among developing countries is presently limited by their dependence upon external sources of weapons: unless additional supplies are obtained, when the existing weapons supply is exhausted, the war grinds to a halt. The acquisition of substantial arms production capabilities could limit the effectiveness of constraints resulting from dependence upon arms imports.

Developing country arms production also has serious implications for arms control efforts to control the horizontal proliferation of conventional arms. Measures designed to control the transfer of arms will become increasingly inadequate. Developing countries will be able to sidestep efforts to control the spread of conventional arms by producing arms themselves and exporting them to each other. Because of the strength of economic incentives to export arms, developing countries will be disinclined to adhere to the rules of any arms control regime established by the advanced industrial states.

Since the motivation to produce and export arms is often economic as well as military, future arms control measures will have to take economic considerations more fully into account. Arms control will become entangled in the problems of economic development since developing countries often regard the acquisition of arms production capabilities as an integral part of the industrialization process. With the increasing complexity of the considerations that must be taken into account, the formulation of effective arms control measures will become qualitatively more difficult.

Though seldom headline grabbing today, the potential problems posed by developing country arms production can only proliferate with time. Since effective efforts to deal with those problems must be grounded in an adequate understanding of the phenomenon, this Note has attempted to help lay the foundation for that understanding.

Appendix

Sources and Methodology

Each country's arms production was coded for three years, 1960, 1970, and 1980, according to the five stages described earlier. The coding for each year is based upon the production actually occurring during that year. In some cases, however, systems that had been produced since the last year coded but not actually in production during next year coded were also included if the production capability still existed. Thus the production indicated as occurring during 1970 includes some weapons produced during the 1960s (excluding 1960, of course) but not actually being produced in 1970, as well as systems in production in 1970. This was done so as not to misrepresent the arms production capability of any given country. Since a country may have manufactured a particular system throughout the 1970s but not in 1980 itself, it would have been a misrepresentation to exclude it from the arms production count altogether. This method of coding was deemed both more comprehensive and more accurate.

The data presented in the tables are based on an extensive bibliographic search, utilizing on-line computer sources, indexes to military, political, and economic journals, and issue-by-issue examination of numerous journals. Three primary sources have been the various editions of *Jane's*, SIPRI's yearbooks, *World Armaments and Disarmament*, and Peter Lock and Herbert Wulf's *Register of Arms Production in Developing Countries*, Hamburg: March 1977, mimeo. The indexes and periodicals consulted are listed below.

INDEXES

Economic Abstracts International
GPO Monthly Catalog
Predicasts Dialog File 7: Social Science Citation Index
Predicasts Dialog File 16: PROMT
Predicasts Dialog File 47: Magazine Index
Public Affairs Information Service
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JOURNALS AND PERIODICALS

Armies and Weapons
Armor
Aviation Week and Space Technology
Defense and Economy World Report and Survey
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DMS Market Intelligence Reports Foreign Military Markets South America, Australasia, DMS Inc., 1980
Far Eastern Economic Review
Ground Defense International
International Defense Review
Military Technology and Economics
Navy International
Strategic Middle Eastern Affairs
Strategic Mid-East and Africa
Strategy Week

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